Indiana Michigan
Power Company
500 Circle Drive
Buchanan, MI 49107 1395

INDIANA MICHIGAN POWER

August 19, 2003

AEP:NRC:3054-13
10 CFR 50.4

Docket Nos: 50-316

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop O-P1-17
Washington, DC 20555-0001

Donald C. Cook Nuclear Plant Unit 2
UNIT 2 VESSEL HEAD INSPECTION RESULTS

Reference:

1. U. S. Nuclear Regulatory Commission Order EA-03-009, "Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors," dated February 11, 2003

2. Letter from W. H. Ruland, Nuclear Regulatory Commission, to A. C. Bakken III, Indiana Michigan Power Company, "Donald C. Cook Nuclear Plant, Unit 2 – Relaxation of the Requirements of Order (EA-03-009) Regarding Reactor Pressure Vessel Head Inspections (TAC No. MB9543)," dated June 17, 2003

3. Letter from W. H. Ruland, Nuclear Regulatory Commission, to A. C. Bakken III, Indiana Michigan Power Company, "Donald C. Cook Nuclear Plant Unit No. 2 – Relaxation of the Requirements of Order (EA-03-009) Regarding Reactor Pressure Vessel Head Inspections (TAC Nos. MB8205 and MB8206)," dated June 17, 2003

This letter provides information pertaining to reactor pressure vessel (RPV) head inspections performed at Donald C. Cook Nuclear Plant Unit 2. Submittal of this information is required by the referenced Nuclear Regulatory Commission Order.

A101

The referenced order imposed enhanced requirements for inspection of pressurized water RPV heads and related penetration nozzles. In accordance with Section IV.C of the order and relaxations approved per References 2 and 3, Indiana Michigan Power Company (I&M) conducted non-destructive examinations of the Unit 2 RPV penetration nozzles and a bare-metal visual examination of the upper surface of the RPV head during the refueling outage that ended June 20, 2003. In accordance with Section IV.E of the order, I&M hereby submits reports of these examinations. Attachment 1 provides the report of the non-destructive examination of the RPV nozzles. Attachment 2 provides the report of the bare metal visual examination of the RPV head upper surface.

The visual inspections performed in accordance with Section IV.D of the order during the Unit 2 refueling outage did not identify any leaks or boron deposits from pressure retaining components on or above the RPV head. Therefore, no report regarding that inspection is required by Section IV.E of the order.

This letter contains no new commitments. Should you have any questions, please contact Mr. Brian A. McIntyre, Manager of Regulatory Affairs, at (269) 697-5806.

Sincerely,

John A. Zwolinski
Director, Design Engineering and Regulatory Affairs

DB/rdw

Attachments:

1. Westinghouse Report 1302426-03, Revision 1
2. Summary Report – Bare Metal Visual Examination of the Donald C. Cook Nuclear Plant Unit 2 Reactor Pressure Vessel Head

c: Director, Office of Nuclear Reactor Regulation
J. L. Caldwell, NRC Region III
K. D. Curry, Ft. Wayne AEP, w/o attachments
J. T. King, MPSC, w/o attachments
MDEQ – WHMD/HWRPS, w/o attachments
NRC Resident Inspector
M. A. Shuaibi, NRC Washington DC

bc: M. J. Finissi, w/o attachments
D. J. Garner
D. R Hafer
D. W. Jenkins, w/o attachments
J. A. Kobyra, w/o attachments
B.A. McIntyre
J. E. Newmiller
D. J. Poupard
R. P. Powers, w/o attachments
M. K. Scarpello
C. L. Vanderniet
S. Vazquez/C. R. Lane/K. R. Worthington
T. K. Woods
J. A. Zwolinski

ATTACHMENT 1 TO AEP:NRC:3054-13

Westinghouse Report 1302426-03, Revision 1

D. C. Cook Unit 2 U2-C14 Reactor Vessel Head Penetration Examination

Dated August 4, 2003

D.C. Cook Unit 2 U2-C14 Reactor Vessel Head Penetration Examination

May 2003

Final Report

1302426-03, Rev. 1

August 4, 2003

Westinghouse Electric Company
Nuclear Services
Waltz Mill Service Center
P.O. Box 158
Madison, Pennsylvania 15663
USA

Table of Contents

Data Disks – 5/2003

J-Groove Weld and Penetration Tube OD Surface Eddy Current Examinations

1. D.C. Cook Unit 2 Grooveman Eddy Current Data, Roof & Tube Scans, Penetrations 1-9

7010 Open Housing Scanner Ultrasonic and Eddy Current Examinations – Vent Tube

1. D.C. Cook Unit 2 Vent Line Tube & Vent Cal Files, Disk 1 of 1

7010 Open Housing Scanner (OHS) Ultrasonic and Eddy Current Examinations - Penetrations

1. D.C. Cook Unit 2 7010 OHS Data, Disk 1 of 5 – Penetrations 10,11,12,13,18
2. D.C. Cook Unit 2 7010 OHS Data, Disk 2 of 5 – Penetrations 19,20,21,24,62
3. D.C. Cook Unit 2 7010 OHS Data, Disk 3 of 5 – Penetrations 63,64,65,74
4. D.C. Cook Unit 2 7010 OHS Data, Disk 4 of 5 – Penetrations 75,76,77,78
5. D.C. Cook Unit 2 7010 OHS Data, Disk 5 of 5 – OHS Calibrations

Gapscanner Penetration Tube ID Surface Combination Probe Examinations

1. D.C. Cook Unit 2 Combo Blade Probe, Disk 1 of 5 – Penetrations 14-17,22,23,25-33
2. D.C. Cook Unit 2 Combo Blade Probe, Disk 2 of 5 – Penetrations 34-48
3. D.C. Cook Unit 2 Combo Blade Probe, Disk 3 of 5 – Penetrations 49-61
4. D.C. Cook Unit 2 Combo Blade Probe, Disk 4 of 5 – Penetrations 66-73
5. D.C. Cook Unit 2 Combo Blade Probe, Disk 5 of 5 – Combo Blade Probe Calibration Files

Gapscanner Penetration Tube ID Surface Eddy Current Examinations

1. D.C. Cook Unit 2 ET-GAP, Disk 1 of 1 – Penetrations 1-9

Gapscanner Penetration Tube ID Surface Eddy Current Examinations After Repair

1. D.C. Cook Unit 2 ET-GAP After Repair, Disk 1 of 1 – Penetrations 43 and 74

Vent Line Weld Eddy Current Examination

1. BV-1, 4/14/03, RPVH Vent Tube J-Weld EC Examination

1.0 INTRODUCTION

During the D.C. Cook Unit 2 U2-C14 outage in May 2003, Westinghouse performed nondestructive examinations (NDE) of the reactor vessel head penetrations, the reactor vessel head vent line and the head vent line weld.

The purpose of the examination program was to identify primary water stress corrosion cracking (PWSCC) that might be present on the OD and ID surfaces of the head penetration tubes, the vent line tube and the vent line weld; and to identify any loss of integrity in the penetration tube shrink fit area that might suggest a leak path. Examinations were performed using procedures and techniques demonstrated through the EPRI/MRP protocol, and/or Westinghouse internal demonstrations in accordance with ASME XI, and applied in a manner acceptable within the context of the February 11, 2003, USNRC Order EA-03-009, "Establishing Interim Inspection Requirements for Reactor Vessel Heads at Pressurized Water Reactors" and approved relaxation requests.

The reactor vessel head at D.C. Cook Unit 2 is a Westinghouse design and manufactured by Chicago Bridge & Iron in Memphis, TN. The head contains 78 alloy 600 penetration tubes that are shrunk fit in the reactor vessel head and attached with alloy 182/82 partial penetration J-groove welds. The head also contains one alloy 600 vent tube, attached to the vessel head with an alloy 182/82 attachment weld.

There are a variety of configurations for the 78 penetration tubes, each configuration requiring special consideration for examination. The penetration tubes measure 4.0" on the OD and have an ID dimension of 2.75". The wall thickness is 0.625". The penetration tube configurations are as follows:

- 53 penetration tubes with thermal sleeves installed
- 7 penetration tubes with part length drive shafts
- 12 "dummy" penetration tubes and one penetration tube used as a head vent without thermal sleeves
- 5 thermocouple column locations without thermal sleeves

The vent line tube has a nominal ID dimension of 0.614" and a nominal OD dimension of 1.0".

The nondestructive examinations performed by Westinghouse were conducted in accordance with the following field service procedures and field change notices (FCNs). With the exception of the vent line examination procedures; WDI-UT-011, Rev 2, WDI-STD-101, Rev. 0 and WDI-STD-114, Rev. 0, all have been demonstrated through the EPRI/MRP protocol. In the absence of an EPRI/MRP protocol for the vent line applications, the examination procedures and techniques are based on processes demonstrated by Westinghouse.

- WDI-ET-002, Rev 2 and FCNs-01 and 02 – "Eddy Current Inspection of J-Groove Welds in Vessel Head Penetrations"
- WDI-ET-003, Rev. 4 and FCN-01 – "IntraSpect Eddy Current Imaging Procedure for Inspection of Reactor Vessel Head Penetrations"

- WDI-ET-004, Rev. 2 and FCN-01 – "IntraSpect Eddy Current Analysis Guidelines Inspection of Reactor Vessel Head Penetrations"
- WDI-ET-008, Rev. 1 and FCNs 01 and 02 – "IntraSpect Eddy Current Imaging Procedure for Inspection of Reactor Vessel Head Penetrations With Gap Scanner"
- WDI-UT-010, Rev 4 and FCNs-01, 02, 03, 04, and 05 - "IntraSpect Ultrasonic Procedure for Inspection of Reactor Vessel Head Penetrations, Time of Flight Ultrasonic & Longitudinal Wave"
- WDI-UT-011, Rev 2 and FCNs 01 and 02 - "IntraSpect NDE Procedure for Inspection of Reactor Vessel Head Vent Tubes"
- WDI-UT-013, Rev 2 and FCNs 01, 02 and 03 – "CRDM/ICI UT Analysis Guidelines"
- WDI-STD-101, Rev. 0 – "RVHI Vent Tube J-Weld Eddy Current Examination"
- WDI-STD-114, Rev. 0 – "Acquisition Technique Sheet for 12-Coil Probe Array for RPVH Vent Tube ID Inspection"
- WCAL-002, Rev. 2 – "Pulser/Receiver Linearity Procedure"

The vessel head penetrations were dispositioned based on an assessment of results from the nondestructive examinations presented herein and results from visual examinations performed from the top of the reactor vessel head.

2.0 SCOPE OF WORK

The reactor vessel head penetration nondestructive examination scope at D.C. Cook Unit 2 included the following:

- Examinations of the penetration tubes were performed using three approaches. The approach selected for each penetration was dependent upon the penetration tube configuration and penetration-specific conditions:

  1) Eighteen penetration tubes without thermal sleeves were examined from the ID using the Westinghouse 7010 Open Housing Scanner. The vent tube was also examined from the ID using the 7010 Open Housing Scanner.

  2) Fifty-one penetration tubes, 44 containing thermal sleeves and 7 part length locations, were inspected from the ID using the Westinghouse Gapscanner and "combination" blade probes which of perform TOFD ultrasonic examinations and eddy current examinations simultaneously.

  3) The remaining nine sleeved penetrations were inspected from the ID using the Westinghouse Gapscanner with eddy current probes and also examined using eddy current techniques on the J-groove welds and on the outside diameter (OD) surfaces of the penetration tubes. The examination program for these penetrations was changed from combination probes to the narrower eddy current probes because the centering buttons in these penetrations are at elevations and circumferential locations which could interfere with the free motion of the combination probe.

- The vent line weld was examined using eddy current and liquid penetrant techniques.

- A supplementary eddy current examination was performed from the ID of the vent tube using an array of 12 plus-point coils and a bobbin probe.

The delivery system used for the vessel head penetration examinations at D.C. Cook Unit 2 was the Westinghouse DERI 700 manipulator.

The DERI 700 is a multi-purpose robot that can access all head penetrations and provides a common platform for all reactor vessel head penetration examination end effectors. The manipulator consists of a central leg, mounted on a carriage, which in turn is mounted onto a guide rail. The manipulator arm, with elbow and removable wrist, is mounted onto the carriage, which travels vertically along the manipulator leg.

The DERI 700 was used to deliver 1) the Westinghouse 7010 Open Housing Scanner for eddy current, ultrasonic time-of-flight and straight beam pulse-echo examinations of penetration locations without thermal sleeves, 2) the Westinghouse Gapscanner end effector for time-of-flight ultrasonic and eddy current examinations of penetration locations containing thermal sleeves and 3) the Grooveman end effector for eddy current examinations of the J-groove welds and penetration tube OD surfaces.

The Westinghouse 7010 Open Housing Scanner delivers an examination wand containing ultrasonic and eddy current probes to the ID surface of open reactor vessel head penetrations. The scanning

motion is in the axial direction and the probe is indexed in the circumferential direction. With the open housing scanner, four examinations are conducted simultaneously. These include:

1) Eddy current examination for identification of circumferential and axial degradation on the ID surfaces of the penetration tubes

2) Time-of-flight diffraction ultrasonic examination optimized for identification of circumferentially oriented degradation on the penetration tube OD surfaces

3) Time-of-flight diffraction ultrasonic examination optimized for identification of axially oriented degradation on the penetration tube OD surfaces

4) Straight beam ultrasonic examination to identify variations in the penetration tube-to-reactor vessel head shrink fit area that might indicate a leak path and for identification of degradation in the weld fusion zone, parallel to the tube-to-weld interface.

The Gapscanner end effector delivers eddy current and "combination" eddy current/TOFD ultrasonic blade probes into the annulus between the ID surface of the reactor vessel head penetration tube and the OD surface of the thermal sleeve. The TOFD ultrasonic probes operate in two modes, one for detection of degradation and one for identification of leak paths in the shrink-fit area. The typical annulus size is 0.125". The blade probe design utilizes a flexible metal "blade" on which ultrasonic and/or eddy current probes are mounted in a spring configuration that enables the probes to ride on the ID surface of the penetration tubes. The scanning motion is in a vertical direction moving from a specified height above the weld, in this case at least 2.0", toward the lower end of the penetration. The probes are indexed in the circumferential direction. The Gapscanner end effector also has a probe tilt and drive unit to advance and reverse the probe in the tube/thermal sleeve annulus, a turntable to rotate the probe drive around the axis of the penetration, a lifting cylinder to raise and lower the tilt and drive unit and a centering device consisting of two clamping arms.

The Grooveman end effector delivers eddy current probes for examination of the surface of the J-groove welds and the penetration nozzle OD surfaces. The eddy current probe holders are designed to conform to the geometry of the J-groove welds and penetration OD surfaces and allow the probes to follow the contour of the assembly. Continuous positional and video feedback is provided to the operator to assist in achieving coverage of the weld and the penetration tube. Scanning of the penetration tube OD surface is typically conducted in a vertical direction and the probes are indexed in the circumferential direction. For scanning of the J-groove welds, scanning is conducted in the circumferential direction, along the weld, and the index is in a direction perpendicular to the weld.

The vent line weld scanner is a device which is delivered manually beneath the head and delivers an array of twelve plus-Point eddy current coils to the vent tube J-weld surface. The entire weld is examined with two 360 degree scans.

The supplementary vent tube inspection with the 12 coil array and the bobbin probe was delivered manually beneath the head. The probe is designed to detect degradation in the vent tube.

2.1 7010 Open Housing Scanner Ultrasonic and Eddy Current Examinations

7010 Open Housing Scanner examinations were conducted on eighteen reactor vessel head penetrations and the reactor vessel vent line.

Examinations of the vessel head penetrations included:

1) TOFD ultrasonic techniques demonstrated capable of detecting axial and circumferential reflectors on the penetration tube OD surfaces with PCS24 probes in accordance with WDI-UT-010, Rev. 4 and FCNs 01, 02, 03, 04, and 05 – "IntraSpect Ultrasonic Procedure for Inspection of Reactor Vessel Head Penetrations, Time of Flight Ultrasonic Longitudinal Wave" & Shear Wave"

2) straight beam ultrasonic techniques at 2.25 MHz to interrogate the J-grove weld zone interface and to identify possible leak paths in the shrink fit region between the head penetrations and the reactor vessel head, and

3) eddy current examinations demonstrated capable of detecting axial and circumferential degradation on the penetration tube ID surfaces in accordance with and WDI-ET-003, Rev. 4 and FCN 01- "IntraSpect Eddy Current Imaging Procedure for Inspection of Reactor Vessel Head Penetrations".

Examinations of the reactor vessel head vent included:

1. Forty-five degree shear wave ultrasonic techniques at 7.5 to 10.0 MHz, to interrogate the vent tube, and

2. eddy current examinations capable of detecting axial and circumferential degradation on the vent tube penetration tube ID surfaces.

The vent line examinations were performed in accordance with WDI-UT-011, Rev. 2 and FCNs 01 and 02 - "IntraSpect NDE Procedure for Inspection of Reactor Vessel Head Vent Tubes".

The supplementary vent tube ID inspection with a 12 coil array and bobbin probe was performed in accordance with WDI-STD-114, Rev. 0 – "Acquisition Technique Sheet for 12-Coil Probe Array for RPVH Vent Tube ID Inspection".

2.2 Gapscanner Penetration Tube ID Surface Eddy Current and Combination Probe Examinations

Examinations were performed with the Gapscanner end effector on a total of sixty penetration tubes from the penetration ID surfaces.

Forty-four penetration tubes containing thermal sleeves and the seven part length locations were inspected from the ID using the Westinghouse Gapscanner and "combination" blade probes capable of performing TOFD ultrasonic examinations, examinations for identification of the shrink-fit area, and eddy current examinations simultaneously. These examinations were performed in accordance with WDI-UT-010, Rev. 4 and FCNs 01, 02, 03, 04 and 05 – "IntraSpect Ultrasonic Procedure for Inspection of Reactor Vessel Head Penetrations, Time of Flight Ultrasonic Longitudinal Wave" & Shear Wave" and

WDI-ET-008, Rev. 1 with FCN 01 – "Intraspect Eddy Current Imaging Procedure for Inspection of Reactor Vessel Head Penetrations With Gapscanner".

The nine sleeved penetrations in the center of the head (Locations 1 through 9) were inspected from the ID using the Westinghouse Gapscanner with eddy current probes. These probes were selected because they are narrower than the combination probes. The centering buttons in these penetrations are at elevations which could interfere with the free vertical motion of the combination probe, even when the "lift and rotate" capability of the Gapscanner is used. These examinations were conducted in accordance with WDI-ET-008, Rev. 1 and FCN 01 – "IntraSpect Eddy Current Imaging Procedure for Inspection of Reactor Vessel Head Penetrations With Gap Scanner". The penetration tube OD surfaces and the J-groove welds at these locations were also examined with the Grooveman eddy current end effector.

2.3 Vent Line Weld Eddy Current and Dye Penetrant Examinations

An eddy current examination was conducted on the vent line J-groove weld. This examination is designed to identify the presence of primary water stress corrosion cracking on the surface of the J-groove weld attaching the vent line to the reactor vessel head. This examination was conducted in accordance with WDI-STD-101, Rev. 0 – "RVHI Vent Tube J-Weld Eddy Current Examination".

In addition, a liquid penetrant examination was performed on the vent line J-groove weld by Cook personnel.

2.4 J-Groove Weld and Penetration Tube OD Surface Eddy Current Examinations

Grooveman eddy current examinations were conducted on the J-groove welds and outside diameter surfaces of the nine reactor vessel head penetration tubes at the center of the head (Locations 1 through 9). These examinations are designed to identify the presence of primary water stress corrosion cracking on the outside diameter surfaces of the penetration tubes and on the surfaces of the J-groove welds attaching the penetrations to the reactor vessel head. Examinations were conducted in accordance with WDI-ET-002, Rev. 2 and FCNs 01 and 02 – "IntraSpect Eddy Current Inspection of J-Groove Welds in Vessel Head Penetrations".

3.0 EXAMINATION RESULTS

3.1 7010 Open Housing Scanner Ultrasonic and Eddy Current Examinations

The following table provides a summary of the final disposition of results for all 7010 Open Housing Scanner RVHP nondestructive examinations performed at D.C. Cook Unit 2 during the U2-C14 May 2003 refueling outage.

Eighteen penetrations without thermal sleeves and the reactor head vent line were inspected from the ID using the Westinghouse Open Housing Scanner.

Penetration #	Axial TOFD Channel 1	Circ TOFD Channel 2	2.25 Mhz 0° Channel 3	ECT Results
10	NDD	NDD	NDD	NDD
11	NDD	NDD	NDD	NDD
12	NDD	NDD	NDD	NDD
13	NDD	NDD	NDD	NDD
18	NDD	NDD	NDD	NDD
19	NDD	NDD	NDD	NDD
20	NDD	NDD	NDD	NDD
21	NDD	NDD	NDD	NDD
24	NDD	NDD	NDD	NDD
62	NDD	NDD	NDD	NDD
63	NDD	NDD	NDD	NDD
64	NDD	NDD	NDD	CC
65	NDD	NDD	NDD	NDD
74	NDD	NDD	NDD	CC
75	NDD	NDD	NDD	NDD
76	NDD	NDD	NDD	NDD
77	NDD	NDD	NDD	NDD
78	NDD	NDD	NDD	NDD

Legend

CC **Craze Cracking**
PTI **Parent Tube Indication**
WII **Weld Interface Indications**
SGI **Surface Geometry Indication**
IPA **Indication Profile Analysis**

Penetration #75 was also examined by liquid penetrant on the penetration tube OD surface. No indications were detected. This examination was performed by Cook personnel.

Two penetrations; #64 and 74 showed eddy current indications on the ID surfaces of the tubes characteristic of craze cracking (CC). All other examinations were dispositioned as NDD (No Detectable Degradation). There were no indications of leak paths identified in the shrink-fit areas.

The reactor vessel head vent line was also examined with the Westinghouse open housing scanner.

Penetration #	10.0 Mhz 45°	ECT Results
Vent Line	NDD	NDD

No reportable indications were identified with the eddy current or ultrasonic examinations.

Results from the supplementary vent tube ID inspection with the 12 coil array and bobbin probe also showed no detectable degradation. Details of this examination and results are included in Appendix 1.

3.2 Gapscanner Penetration Tube ID Surface Eddy Current and Combination Probe Examinations

The following table provides a summary of the final disposition of results for all Gapscanner examinations performed at D.C. Cook Unit 2 during the U2-C14 May 2003 refueling outage.

Forty-four penetration tubes containing thermal sleeves and 7 part length locations; penetrations #14 through 17, 22, 23, 25 through 61 and 66 through 73, were inspected from the ID using the Westinghouse Gapscanner and "combination" blade probes capable of performing TOFD ultrasonic examinations, examinations for identification of leak paths in the shrink-fit area, and eddy current examinations simultaneously.

Nine sleeved penetrations; #1 through 9, were inspected from the ID using the Westinghouse Gapscanner with eddy current probes.

Penetration #	PCS24 TOFD	Eddy Current Tube ID
1	ECT Blade Probe and Grooveman	NDD
2	ECT Blade Probe and Grooveman	NDD
3	ECT Blade Probe and Grooveman	NDD
4	ECT Blade Probe and Grooveman	NDD
5	ECT Blade Probe and Grooveman	NDD
6	ECT Blade Probe and Grooveman	NDD
7	ECT Blade Probe and Grooveman	NDD
8	ECT Blade Probe and Grooveman	NDD
9	ECT Blade Probe and Grooveman	NDD
10	Open Housing Scanner	Open Housing Scanner
11	Open Housing Scanner	Open Housing Scanner
12	Open Housing Scanner	Open Housing Scanner
13	Open Housing Scanner	Open Housing Scanner
14	NDD	NDD
15	NDD	NDD
16	NDD	NDD
17	NDD	NDD
18	Open Housing Scanner	Open Housing Scanner
19	Open Housing Scanner	Open Housing Scanner
20	Open Housing Scanner	Open Housing Scanner
21	Open Housing Scanner	Open Housing Scanner
22	NDD	NDD
23	NDD	NDD
24	Open Housing Scanner	Open Housing Scanner
25	NDD	NDD
26	NDD	NDD
27	NDD	NDD
28	NDD	NDD
29	NDD	NDD
30	NDD	NDD
31	NDD	NDD

32	NDD	NDD
33	NDD	NDD
34	NDD	NDD
35	NDD	NDD
36	NDD	NDD
37	NDD	NDD
38	NDD	NDD
39	NDD	NDD
40	NDD	NDD
41	NDD	NDD
42	NDD	NDD
43	NDD	CC
44	NDD	NDD
45	NDD	NDD
46	NDD	NDD
47	NDD	NDD
48	NDD	NDD
49	NDD	NDD
50	NDD	NDD
51	NDD	NDD
52	NDD	NDD
53	NDD	NDD
54	NDD	NDD
55	NDD	NDD
56	NDD	NDD
57	NDD	NDD
58	NDD	NDD
59	NDD	CC
60	NDD	NDD
61	NDD	NDD
62	Open Housing Scanner	Open Housing Scanner
63	Open Housing Scanner	Open Housing Scanner
64	Open Housing Scanner	Open Housing Scanner
65	Open Housing Scanner	Open Housing Scanner
66	NDD	NDD
67	NDD	NDD
68	NDD	NDD
69	NDD	NDD
70	NDD	NDD
71	NDD	NDD
72	NDD	NDD
73	NDD	NDD
74	Open Housing Scanner	Open Housing Scanner
75	Open Housing Scanner	Open Housing Scanner
76	Open Housing Scanner	Open Housing Scanner
77	Open Housing Scanner	Open Housing Scanner
78	Open Housing Scanner	Open Housing Scanner

Of the sixty penetrations inspected with the Gapscanner, two (#43 and 59) showed eddy current indications characteristic of craze cracking (CC) on the ID surfaces and fifty-eight showed no detectable degradation (NDD).

No detectable degradation was reported with any of the PCS24 TOFD ultrasonic inspections and no characteristics of leak paths were identified in the shrink-fit areas.

The OD threads of penetration #73 were also examined by liquid penetrant techniques. No indications were detected. This examination was performed by Cook personnel.

3.3 Vent Line Weld Eddy Current and Dye Penetrant Examinations

An eddy current examination was conducted on the vent line J-groove weld. This examination is designed to identify the presence of primary water stress corrosion cracking on the surface of the J-groove weld attaching the vent line to the reactor vessel head. This examination was conducted in accordance with WDI-STD-101, Rev. 0 – "RVHI Vent Tube J-Weld Eddy Current Examination".

Penetration #	12 Coil Array ECT Results
Vent Line Weld	NDD

No detectable degradation was identified in the eddy current examination of the vent line J-groove weld.

Subsequently a liquid penetrant examination was performed on this weld by Cook personnel with no unacceptable conditions identified.

3.4 J-Groove Weld and Penetration Tube OD Surface Eddy Current Examinations

The following table provides a summary of results for all J-groove weld and penetration tube OD surface eddy current examinations performed on the D.C. Cook Unit 2 reactor vessel head during the U2-C14 refueling outage.

Tube scans were broken into two types of scans, axial as well as circumferential, when it was discovered that the first series of axial tube examinations would not establish the desired coverage due to interference between the tube scan probe holder and the threads. With the additional coverage achieved with the circumferential scans, all penetration tube OD surfaces were examined from the J-groove weld to the thread relief just above the threads on the OD surface of the tubes.

Penetration #	Eddy Current J-Groove Weld	Eddy Current Tube
1	NDD	NDD
2	NDD	NDD
3	NDD	NDD
4	NDD	NDD
5	NDD	NDD
6	NDD	NDD
7	NDD	NDD

8	NDD	NDD
9	NDD	NDD

There were no indications characteristic of cracking identified in any of the nine J-groove welds or the penetration OD surface eddy current examinations.

4.0 DISCUSSION OF RESULTS

Results from all penetration tube examinations are summarized in Table 1 along with the initial Level II assessment and final disposition. Details for each examination performed on each penetration are found in Volume 2.

Results from the nondestructive examinations of the seventy-eight reactor vessel head penetrations, the vent line tube and vent line weld identified two reactor vessel penetration tubes, #43 and #74, with indications on the ID surfaces that were repaired by electron discharge machining (EDM).

Results from the previous examination of penetration #74 in January 2002 showed the same condition existed at that time. An assessment of the eddy current characteristics of the condition in 2002 versus 2003 suggests there had been no extension during the recent operating cycle. Eddy current results, along with estimated individual crack lengths established by proximity rules are provided in figure 3. The depth of this cluster of indications was conservatively estimated by TOFD UT at 0.117". Additional details regarding the examination results and the comparison of the 2002 and 2003 eddy current data are found in Volume 2.

Eddy current results from penetration #43 are provided in figure 4. This cluster of indications is much smaller than that identified in penetration #74 and structural analysis predicts the condition will not grow to a structurally significant size during the next cycle, however it has been identified for repair as a conservative measure. No eddy current examinations were performed on this penetration during the January 2002 inspection program. Additional details regarding the examination results are found in Volume 2.

The EDM excavations in penetrations #74 and #43 were examined using a combination of eddy current from the ID surface and remote dye penetrant. The supplementary dye penetrant examination was necessary to examine small areas near the top and bottom of the excavations where the eddy current probe experienced liftoff. No indications were detected in the repair excavations.

Evidence of craze cracking was also found in penetrations #59 and #64, however these conditions were also much smaller than the cluster identified in penetration #74 and not predicted to show significant extension during the next cycle of operation. No eddy current examinations were performed on penetration #59 during the January 2002 inspection program. Eddy current results on penetration #64 showed no detectable degradation in January 2002. Depths were too shallow to measure with the TOFD UT examinations. There was no evidence of lateral wave disturbance in the TOFD UT results. Details and graphics are found in Volume 2.

During the January 2002 reactor vessel head penetration at D.C. Cook Unit 2, TOFD UT indications were identified in five penetrations (#32, 35, 46, 60 and 65) which were attributed to possible repair areas, with regions of incomplete fusion. The conclusion of the assessment with supplementary ultrasonic and surface examination techniques indicated they were associated with the welding process and not service-related.

Results from the January 2002 TOFD UT examinations of these penetrations, in terms of length and depth, were compared to the results of the May 2003 examination program. In all cases, there was very

good correlation between the January 2002 and May 2003 TOFD UT results. Lengths and depths were found to be well within the range of tolerances expected for such measurements.

These results support the conclusions reached during the January 2002 examination and the supplementary examinations performed at that time.

A summary of data from January 2002 and May 2003 is provided in the table below. When reviewing the actual scan data from the January 2002 examination of penetration #65 it is important to note that the data are corrected to account for a difference in the scan direction for the Open Housing Scanner in January 2002 as compared to the May 2003 results. This difference in circumferential reference has been corrected in the table to aid in review of the results. Data for the other four penetrations were collected with the Gapscanner where there has been no change in scan direction reference. The Gapscanner data correlate directly in terms of penetration azimuth.

No.	PCS24 TOFD - 2002		PCS24 TOFD - 2003	
	Depth	Length	Depth	Length
#32	0.19"	300° to 346°	0.19"	305° to 351°
#46	0.21"	336° to 71°	0.202"	322° to 58°
#35	0.12"	41° to 57°	0.12"	44° to 58°
#60	0.11"	310° to 345°	0.116"	313° to 345°
#65	0.18" 0.11"	259° to 356° 15° to 70°*	0.20" 0.09"	247° to 359° 21° to 67°*

*Intermittant

FIGURE 1 - PENETRATION TUBE ID FLAW EVALUATION

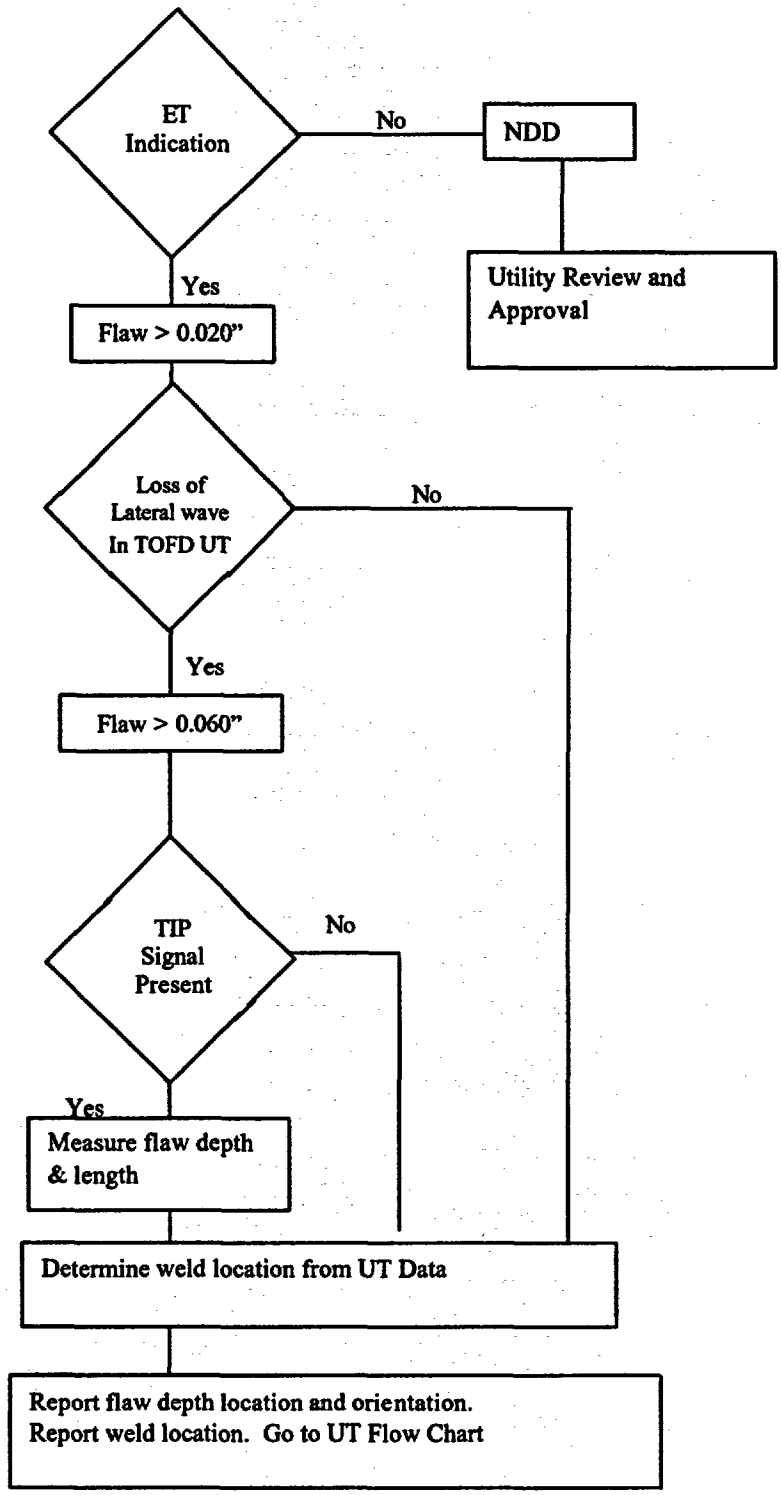
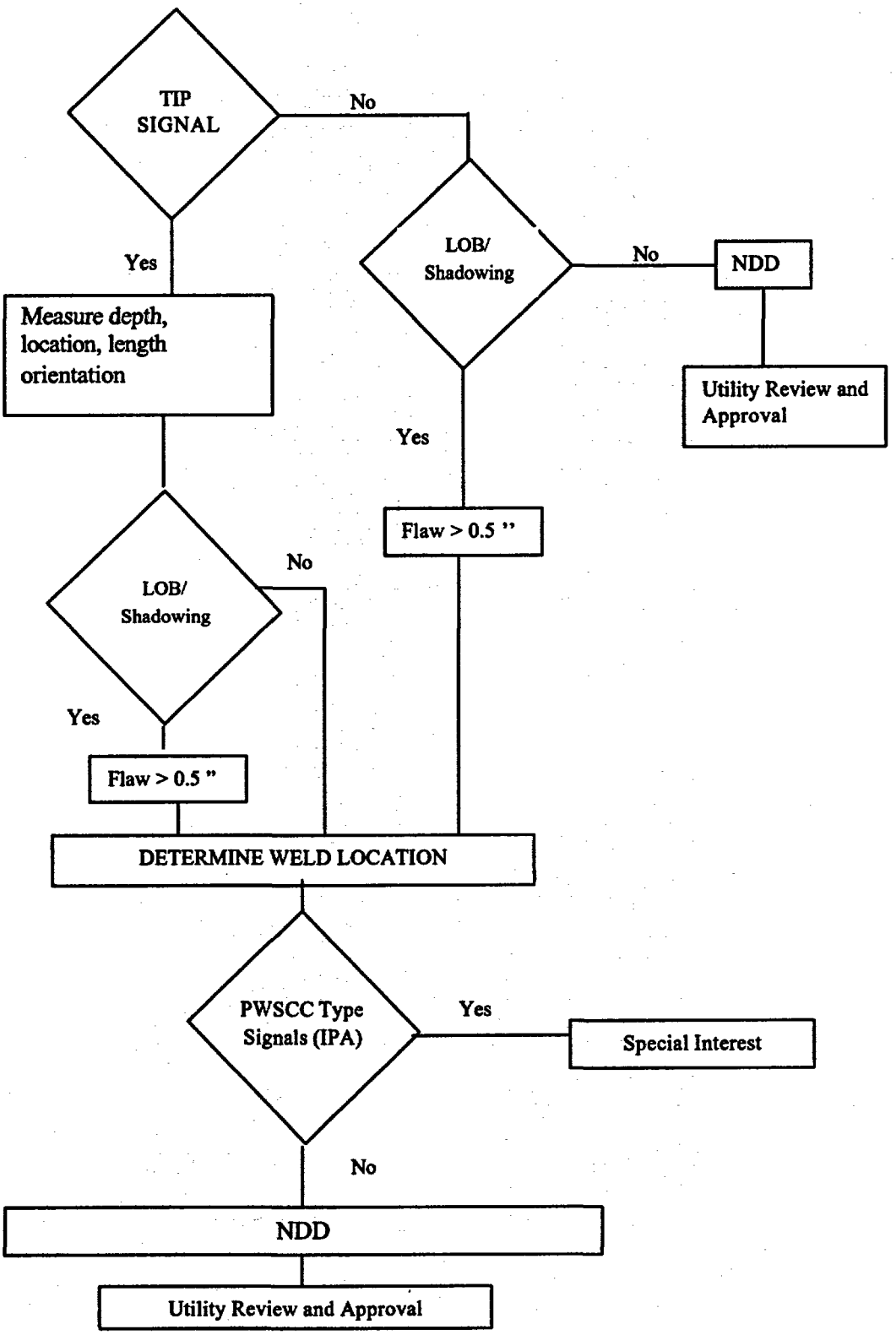
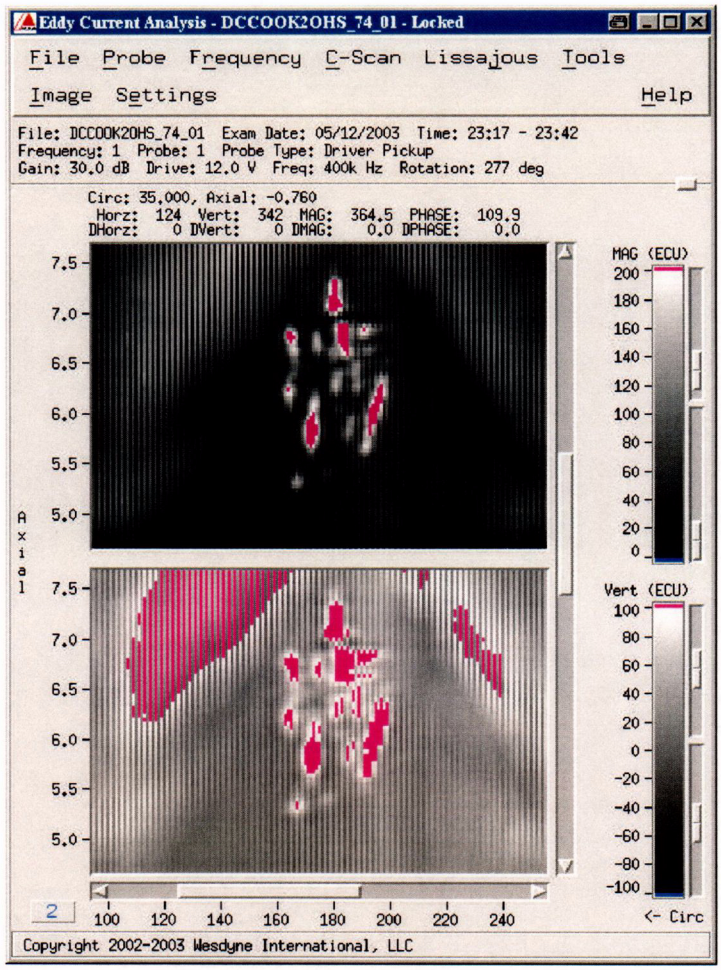


FIGURE 2 - PENETRATION TUBE OD FLAW EVALUATION

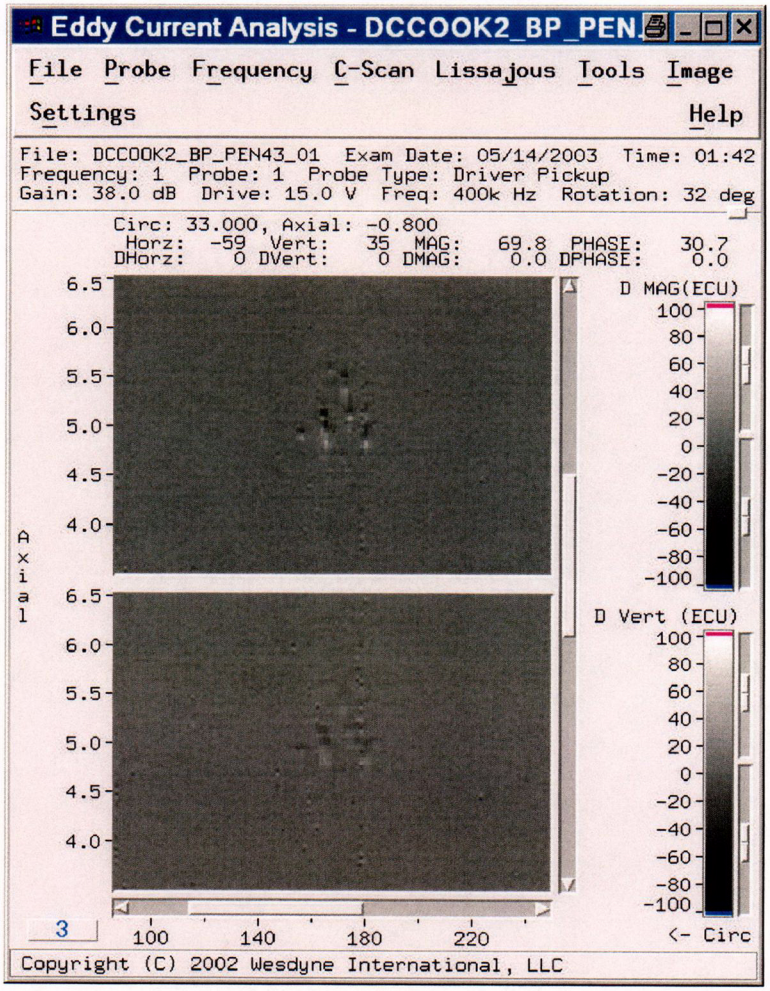




Indication #	Azimuth	Top End	Low End	Length
1	165^0	6.96"	6.0"	0.96"
2	174^0	6.92"	5.24"	1.68"
3	182^0	7.52"	5.36"	2.16"
4	193^0	7.04"	5.72"	1.32"
5	197^0	6.6"	5.44"	1.16"

FIGURE 3 – EDDY CURRENT RESULTS PENETRATION #74 D.C. COOK UNIT 2

C01



Indication #	Azimuth	Top End	Low End	Length
1	156^0	5.38"	5.22"	0.16"
2	165^0	5.62"	5.14"	0.48"
3	172^0	6.02"	5.42"	0.60"
4	180^0	5.70"	5.18"	0.52"

FIGURE 4 – EDDY CURRENT RESULTS PENETRATION #43 D.C. COOK UNIT 2

C02

Table 1: D.C. Cook Unit 2 Examination Tracking Sheet - Spring 2003

	J-Groove Weld and Tube OD				Gapscanner (GS)		Open Housing Scanner (OHS)						OHS or GS	
	Roof	Roof	Tube	Tube	Tube UT	Tube UT	Axial TOFD #1		Circ TOFD #2		2.25MHz 0° #3		ID Eddy Current	
No.	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis
1	x	NDD	x	NDD	—	—	—	—	—	—	—	—	x	NDD
2	x	NDD	x	NDD	—	—	—	—	—	—	—	—	x	NDD
3	x	NDD	x	NDD	—	—	—	—	—	—	—	—	x	NDD
4	x	NDD	x	NDD	—	—	—	—	—	—	—	—	x	NDD
5	x	NDD	x	SGI/NDD	—	—	—	—	—	—	—	—	x	NDD
6	x	NDD	x	NDD	—	—	—	—	—	—	—	—	x	NDD
7	x	NDD	x	NDD	—	—	—	—	—	—	—	—	x	NDD
8	x	NDD	x	NDD	—	—	—	—	—	—	—	—	x	NDD
9	x	NDD	x	NDD	—	—	—	—	—	—	—	—	x	NDD
10	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	NDD
11	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	NDD
12	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	NDD
13	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	NDD
14	—	—	—	—	x	WI/PT/NDD	—	—	—	—	—	—	x	NDD
15	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
16	—	—	—	—	x	WI/PA/NDD	—	—	—	—	—	—	x	NDD
17	—	—	—	—	x	PT/PA/NDD	—	—	—	—	—	—	x	NDD
18	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	NDD
19	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	NDD
20	—	—	—	—	—	—	x	NDD	x	WI/PT/NDD	x	NDD	x	NDD
21	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	NDD
22	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
23	—	—	—	—	x	PT/PA/NDD	—	—	—	—	—	—	x	NDD
24	—	—	—	—	—	—	x	PT/PA/NDD	x	PT/PA/NDD	x	NDD	x	NDD
25	—	—	—	—	x	PT/PA/NDD	—	—	—	—	—	—	x	NDD
26	—	—	—	—	x	PT/WI/NDD	—	—	—	—	—	—	x	NDD
27	—	—	—	—	x	WI/NDD	—	—	—	—	—	—	x	NDD
28	—	—	—	—	x	PT/PA/NDD	—	—	—	—	—	—	x	NDD
29	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
30	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
31	—	—	—	—	x	PT/PA/NDD	—	—	—	—	—	—	x	NDD
32	—	—	—	—	x	PT/PA/NDD	—	—	—	—	—	—	x	NDD
33	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
34	—	—	—	—	x	PT/PA/NDD	—	—	—	—	—	—	x	NDD
35	—	—	—	—	x	PT/PA/NDD	—	—	—	—	—	—	x	NDD
36	—	—	—	—	x	PT/PA/NDD	—	—	—	—	—	—	x	NDD

	J-Groove Weld and Tube OD				Gapscanner (GS)		Open Housing Scanner (OHS)						OHS or GS	
	Roof	Roof	Tube	Tube	Tube UT	Tube UT	Axial TOFD #1		Circ TOFD #2		2.25MHz 0° #3		Eddy Current	
No.	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis
37	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
38	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
39	—	—	—	—	x	PT/IPA/NDD	—	—	—	—	—	—	x	NDD
40	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
41	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
42	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
43	—	—	—	—	x	PT/IPA/NDD	—	—	—	—	—	—	x	CC
44	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
45	—	—	—	—	x	PT/WII/NDD	—	—	—	—	—	—	x	NDD
46	—	—	—	—	x	PT/WII/NDD	—	—	—	—	—	—	x	NDD
47	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
48	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
49	—	—	—	—	x	PT/IPA/NDD	—	—	—	—	—	—	x	NDD
50	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
51	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
52	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
53	—	—	—	—	x	PT/IPA/NDD	—	—	—	—	—	—	x	NDD
54	—	—	—	—	x	PT/IPA/NDD	—	—	—	—	—	—	x	NDD
55	—	—	—	—	x	PT/WII/NDD	—	—	—	—	—	—	x	NDD
56	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
57	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
58	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
59	—	—	—	—	x	NDD	—	—	—	—	—	—	x	CC
60	—	—	—	—	x	PT/NDD	—	—	—	—	—	—	x	NDD
61	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
62	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	NDD
63	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	NDD
64	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	CC
65	—	—	—	—	—	—	x	PT/IPA/NDD	x	PT/IPA/NDD	x	NDD	x	NDD
66	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
67	—	—	—	—	x	PT/IPA/NDD	—	—	—	—	—	—	x	NDD
68	—	—	—	—	x	NDD	—	—	—	—	—	—	x	SG/NDD
69	—	—	—	—	x	PT/WII/NDD	—	—	—	—	—	—	x	NDD
70	—	—	—	—	x	PT/WII/NDD	—	—	—	—	—	—	x	NDD
71	—	—	—	—	x	WII/PT/NDD	—	—	—	—	—	—	x	NDD
72	—	—	—	—	x	NDD	—	—	—	—	—	—	x	NDD
73	—	—	—	—	x	PT/WII/NDD	—	—	—	—	—	—	x	NDD
74	—	—	—	—	—	—	x	PT/WII/CC	x	PT/WII/NDD	x	NDD	x	CC

	J-Groove Weld and Tube OD				Gapscanner (GS)		Open Housing Scanner (OHS)						OHS or GS	
	Roof	Roof	Tube	Tube	Tube UT	Tube UT	Axial TOFD #1		Circ TOFD #2		2.25MHz 0° #3		Eddy Current	
No.	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis	Acquired	Analysis
75	—	—	—	—	—	—	x	NDD	x	PTI/NDD	x	NDD	x	NDD
76	—	—	—	—	—	—	x	NDD	x	PTI/WII/NDD	x	NDD	x	NDD
77	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	NDD
78	—	—	—	—	—	—	x	NDD	x	NDD	x	NDD	x	NDD
Vent	—	—	—	—	—	—	45° x	NDD	—	—	—	—	x	NDD
Weld	x	NDD	—	—	—	—	—	—	—	—	—	—	x	NDD

Legend

CC **Craze Cracking**
PTI **Parent Tube Indication**
WII **Weld Interface Indications**
SGI **Surface Geometry Indication**
IPA **Indication Profile Analysis**

ATTACHMENT 2 TO AEP:NRC:3054-13

SUMMARY REPORT
BARE-METAL VISUAL EXAMINATION OF THE DONALD C. COOK NUCLEAR PLANT UNIT 2 REACTOR PRESSURE VESSEL HEAD

A bare-metal visual examination of the Donald C. Cook Nuclear Plant Unit 2 reactor pressure vessel (RPV) head was conducted during the refueling outage that ended June 20, 2003. This inspection was required by Section IV.C(1)(a) of Nuclear Regulatory Commission Order EA-03-009, "Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors," dated February 11, 2003. The examination was conducted by contractor personnel in conjunction with Performance Verification personnel qualified as VT-2 examiners. A remotely operated crawler and manual guide probes, both equipped with a video camera, were used to examine 360 degrees around each of the 79 RPV head penetrations. A bare-metal visual examination of the sections of RPV head between penetrations was also performed. The inspection results for all penetrations were ultimately categorized as satisfactory.

During the examination, concerns were raised about the ability to categorize inspection results for penetrations where debris had settled in the annulus region, typically on the uphill side of the penetrations. Following the inspection, the entire RPV head was vacuumed to remove the debris. To facilitate the vacuuming, many additional vertical insulation panels and lower step insulation pieces were removed. The head was then reinspected. As a result of the vacuuming, the inspection results for penetrations that had initially been categorized as "indeterminate" calls were changed to "satisfactory."

One additional activity accomplished during the visual inspection was the removal of a small brick that had been discovered during the 2002 inspection. The brick was treated as potential asbestos containing material due to its appearance and the time frame during which it was believed to have been placed on the head (circa 1970). The brick was retrieved and determined to be covered by fiberglass. The brick was tested and found to contain asbestos.